SECRET 25X1

5 DEC 1985

CIA GI 85-10312 M

02 DEC 1985

MEMORANDUM FOR: (See Distribution List)

FROM: 25X1
Chief, Strategic Resources Division
Office of Global Issues

SUBJECT: Northern Ethiopia: Much Improved Harvest for 1985 25X1

1. The attached memorandum is in response to your request for an assessment of the 1985 harvest in northern Ethiopia in the area bounded by 12 degrees north latitude and 40 degrees east longitude. The analysis is based on 25X1 unclassified Landsat imagery taken during 1984 and 1985, 25X1 augmented with meteorological data It 25X1 provides an estimate of the size of the 1984 harvest and a projection of the 1985 harvest, with the significant point being the assessment of the percentage increase in crop production between the two years. 25X1

2. This assessment was produced by 25X1 the Agricultural Assessments Branch, 25X1 Strategic Resources Division, Office of Global Issues. 25X1

3. Comments and questions are welcome and may be addressed to the Chief, Agricultural Assessments Branch, 25X1

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NOT MICROFILMED
Colored photos & maps
For Data Entry

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Attachment: 25X1
Northern Ethiopia: Much Improved Harvest for 1985 , GI M 85-10312, December 1985 25X1

USAF review completed.

NGA Review Complete

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[redacted] 25X1

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SUBJECT: Northern Ethiopia: Much Improved Harvest for 1985 [redacted]

OGI/SRD/AAB/[redacted] (2 December 1985) 25X1

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Central Intelligence Agency

Washington, D.C. 20505

DIRECTORATE OF INTELLIGENCE

02 DEC 1985

Northern Ethiopia: Much Improved Harvest for 1985

Summary

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An analysis of the agricultural areas in northern Ethiopia indicates the 1985 harvest in the region will be approximately 50 percent larger than in 1984. [redacted]. While the overall outlook for the 1985 harvest is favorable, there are still localized areas of real need. The best crops in all provinces appeared at elevations above 6000 feet where rainfall was most plentiful. The deficit areas include the general area west of Asmera in Eritrea, a small region in southern Tigray, and the northwest corner of Welo. Based on very limited data, overall cereal production for northern Ethiopia is estimated at approximately 1.1 million metric tons and pulses are projected to yield 190,000 tons. Because of the lack of data, we have more confidence in our estimate of the percentage change between the sizes of 1984 and 1985 harvests than in these absolute production figures. [redacted]

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This memorandum was prepared by [redacted] the Agricultural Assessments Branch, 25X1
Strategic Resources Division, Office of Global Issues. Comments 25X1
may be directed to [redacted] Chief, Strategic Resources 25X1
Division, [redacted] 25X1

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GI M 85-10312

[redacted]

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[redacted] 25X1

Northern Ethiopia: Much Improved Harvest for 1985

Background

Area of Interest: The principal areas of interest in this assessment are the provinces of Eritrea and Tigray. In addition, 80 percent of the agricultural land in Gonder province and one-third of the agricultural area in Welo province were included in the survey. The southern limit of the surveyed area was the 12 degree north latitude line. The eastern limit was the 40 degree east longitude line. The western and northern boundaries were defined by the Ethiopian border. [redacted] 25X1

Agricultural Constraints: Farming practices in northern Ethiopia are primitive and even with the best of weather conditions yields are not high. For the most part, the soils are shallow, rocky, and sandy. They are also prone to erosion and lack nutrients. Farming is primarily susbsistence level and little if any use is made of fertilizers or improved seed varieties. People and draft oxen provide the basic power needs. [redacted] 25X1

Cropping Patterns: The agricultural year in Ethiopia is marked by light rains from February to May, which result in a small crop in many areas.[1] The major rainy season is from May to September, with the country's main harvest taking place from late September through December. [redacted] 25X1

The major crops grown in the area of interest are teff, sorghum and barley.[2] Sorghum is grown mainly at lower elevations where rainfall is less, while teff is grown at higher elevations where there is more precipitation. Pulses (various peas and beans) account for approximately 15 percent of the area's crops, with small gardens providing a variety of vegetables. Planting of crops can start as early as April or May. [redacted] 25X1

Seedbed preparation is rudimentary with farmers using wooden plows fixed with small iron or steel points which crumble the

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[1] In northern Ethiopia the seasonal "short rains" are less significant and do not allow for much early cropping. [redacted] 25X1

[2] Teff is a cereal unique to Ethiopia. It is usually hand-sown in July or August and resembles lovegrass which is grown in the U.S. as forage. The Ethiopians grow teff for its small seed which they make into flour for a bread called "injera." Although 25X1
teff requires considerable labor and the yields are low, it is 25X1
preferred by the Ethiopians for bread making. Injera made from
teff stays supple for two to three days, whereas bread made from
other grains turns hard within a day. For those eating it, teff 25X1
provides two-thirds of the population's protein intake. [redacted]

[redacted]

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soil. The land is plowed several times during the year in order to increase rainfall absorption and reduce run-off. 25X1

Methodology

The primary goal of this study was to determine the degree of change in the 1985 harvest over that of last year. Unfortunately, the historical record for 1984 is unreliable. Official Ethiopian government statistics for Eritrea and Tigray show no change in crop production since 1979 during a period when the harvest clearly was declining sharply. Data for Welo and Gonder appear reasonable, however, since they show changes in harvest since 1979 that are generally consistent with weather conditions. 25X1

To derive a more reasonable estimate of production in northern Ethiopia for 1984, we:

- Determined the average percentage decrease in yields in Welo and Gonder for 1979-84 from official data.
- Applied this average figure to the 1979 yields in Eritrea and Tigray to get yield estimates for these provinces in 1984.
- Statistically derived the planted area in Eritrea and Tigray 25X1 of sampled areas of agricultural land. 25X1
- Combined the yield estimates with estimates of planted area to obtain production estimates for Eritrea and Tigray for 1984, assuming no change in the percentage of land devoted to cereals and pulses between 1979 and 1984.
- Combined the estimates for Eritrea and Tigray with the appropriate portions of official figures for Welo (33 percent) and Gonder (80 percent) to obtain our best estimate of grain and pulse output in northern Ethiopia in 1984. 25X1

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In inaccessible areas, we believe the best estimate of the health and vigor of a crop is derived from Landsat imagery (see attached Landsat photos) and we acquired total coverage of the northern area of Ethiopia with this system during the 1985 growing season. From experience with imagery in other regions of the world, where satellite data have been correlated with actual yields, an objective rating scheme has been developed that permits an estimate of the final yield of a crop, based on its vigor during the growing season. In this study, this technique has also been correlated with vigor assessments determined from classfied systems, providing additional confidence in the yield estimate (see attached photos).

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The crops in northern Ethiopia can be classed as good, fair, or poor, on the basis of the vigor analysis, stand density, soil moisture and degree of cumulative plant stress. These categories equate to specific percentages of yield reduction (Table 1). In computing the overall estimated yields for the region, the mid-point of the yield range was used for each category.

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Table 1

Vigor Analysis

State of Crop	Probable Yield (Percent of Historical Maximum)
Good	75 - 100
Fair	45 - 74
Poor	0 - 44

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The 1985 projection was derived by applying estimates of changes in planted area and yields to the corresponding figures for 1984.

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[3] A total of 16 sites were surveyed in 1984 and 15 in 1985. Nine of the sites were identical in both years, providing the best direct comparison between the 1984 and 1985 crops. A non-parametric matched-pair test was performed on the data obtained from the scenes. Based on the assumption that the scenes were truly a random sample, the test provided statistical confirmation that the observed differences between the 1984 and 1985 scenes were genuine and able to be generalized across the entire region (see attached map, Survey Area Location).

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The estimated increase in yields between 1984 and 1985, as determined from vigor analysis, is 30 to 40 percent.

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Crop Estimates

The absolute levels estimated for 1984 and 1985 harvests are scaled from the official Ethiopian government statistics for 1979 (Tables 2 & 3). Given the uncertainty in the 1984 production figures, we are more confident in our estimates of the percentage increase between 1984 and 1985 than the absolute levels projected. They indicate about a fifty percent improvement in the harvest over 1984 for this region of northern Ethiopia (Table 4).

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Table 2

1979 Crop Production[1]
Northern Ethiopia

Crop	Area (Hectares, 1000s)[2]	Production (Metric tons, 1000s)
Cereals	1154.48	984.0
Pulses	277.79	166.2

[1] Includes Eritrea and Tigray Provinces, plus 80 percent of figure reported for Gonder and 33 percent reported for Welo Provinces.

[2] Hectare equals 10,000 square meters.

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Table 3

1984-85 Estimated Crop Production
Northern Ethiopia

Crop	Area (Hectares, 1000s)		Production (Metric Tons, 1000s)	
	1984	1985	1984	1985
Cereals	1200	1300	770	1100-1200
Pulses	280	310	130	190- 200

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Because of the averaging techniques that had to be used to derive the figures for 1985, we cannot project specific figures by province. However, specific regions of need can be identified

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In general, the crop situation in Eritrea is not very favorable, with approximately 60 percent of the fields being fair and the remainder poor. The situation in Tigray is better, with about 55 percent being rated fair, nearly one-third rated good, and only 15 percent evaluated as poor. In the northwest corner of Welo, that portion of the province that was surveyed, about half of the crops were estimated to be in fair condition, with approximately 40 percent rated poor and the remainder determined to be in good condition. The region of Gonder that was surveyed, which included 80 percent of the agricultural land in the province, had an excellent crop with 90 percent being rated good. The remainder of the crop, located in the east of the province, was fairly evenly divided between fair and poor conditions. Although most agriculture is found between 4000 and 7000 feet in the region, the best crops appeared at elevations above 6000 feet where rainfall was most plentiful.

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Table 4

Estimated Percentage Increase
1984-1985 Agricultural Production
Northern Ethiopia

Crop	1984 Production (Metric Tons, 1000s)	1985 Production (Metric Tons, 1000s)	Percentage Increase (1984-1985)
Cereals	770	1100 - 1200	+43 - +56
Pulses	130	190 - 200	+46 - +54

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Weather Summary Supports Crop Estimate

An analysis of rainfall data indicates that precipitation in 1985 was significantly greater than in 1984 and the best since 1979. The rain patterns follow the topography of the country, with the greatest rainfall being in the areas of highest elevation. In the northern areas the 1985 rainfall was approximately equal to the average for the past 15 years. The 1984 rainfall levels, however, were well below the 15 year norm (see attached weather maps). Nonethless, the areas of higher precipitation in 1984 and 1985 generally match those of higher yields that we identified by vigor analysis.

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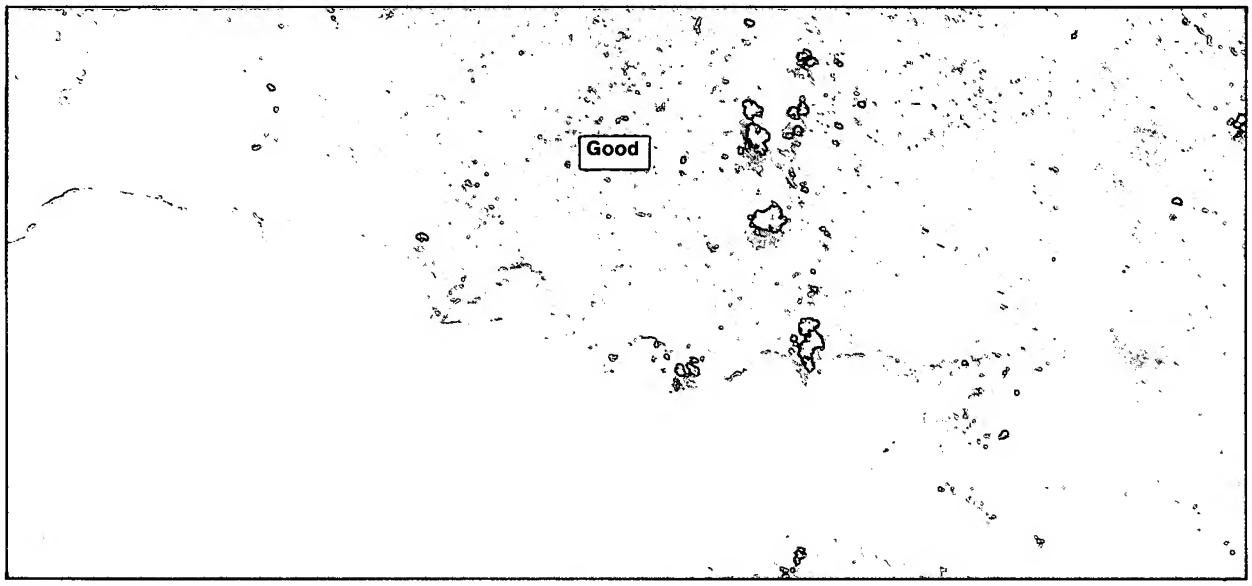
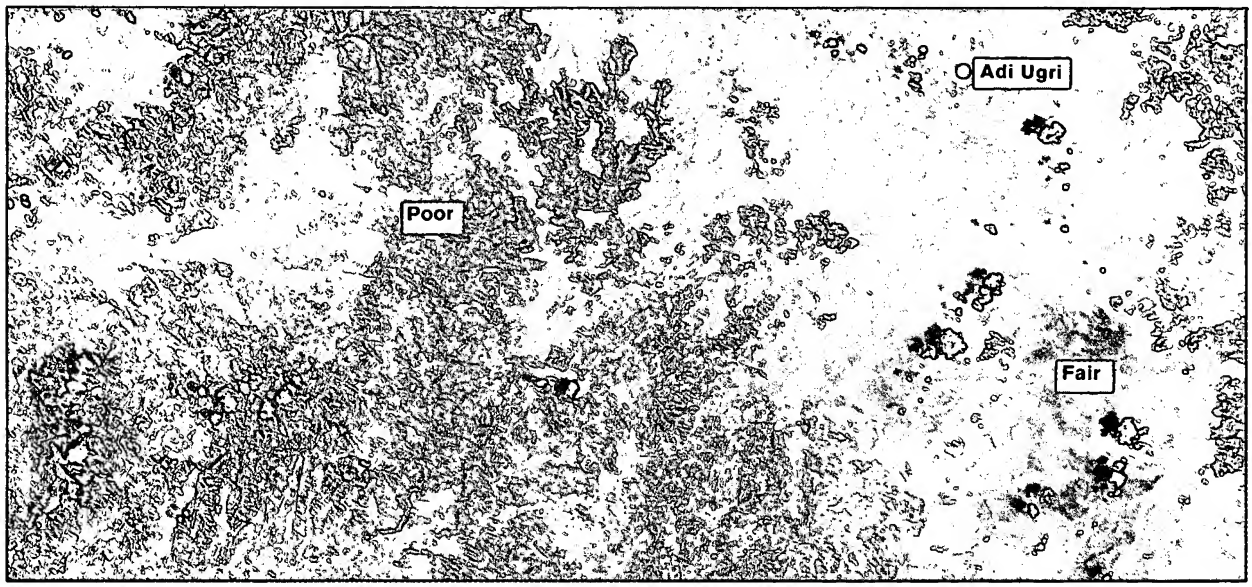
Northern Ethopia: 1985 Crop Vigor Comparison From Landsat Imagery

Gonder Province
29 September 1985



Eritrea Province
8 October 1985



Late season Landsat imagery of Northern Ethiopia shows wide variation in crop vigor this year. Growing conditions in Gonder Province have been mostly favorable during the 1985 crop season. The vivid infrared return on the top photo indicates good crop vigor and above average yields are expected. By contrast, crop vigor in Eritrea Province ranged from poor to fair. The lack of red color depicts a marked reduction in crop vigor from that observed in Gonder and yields are expected to be much less.

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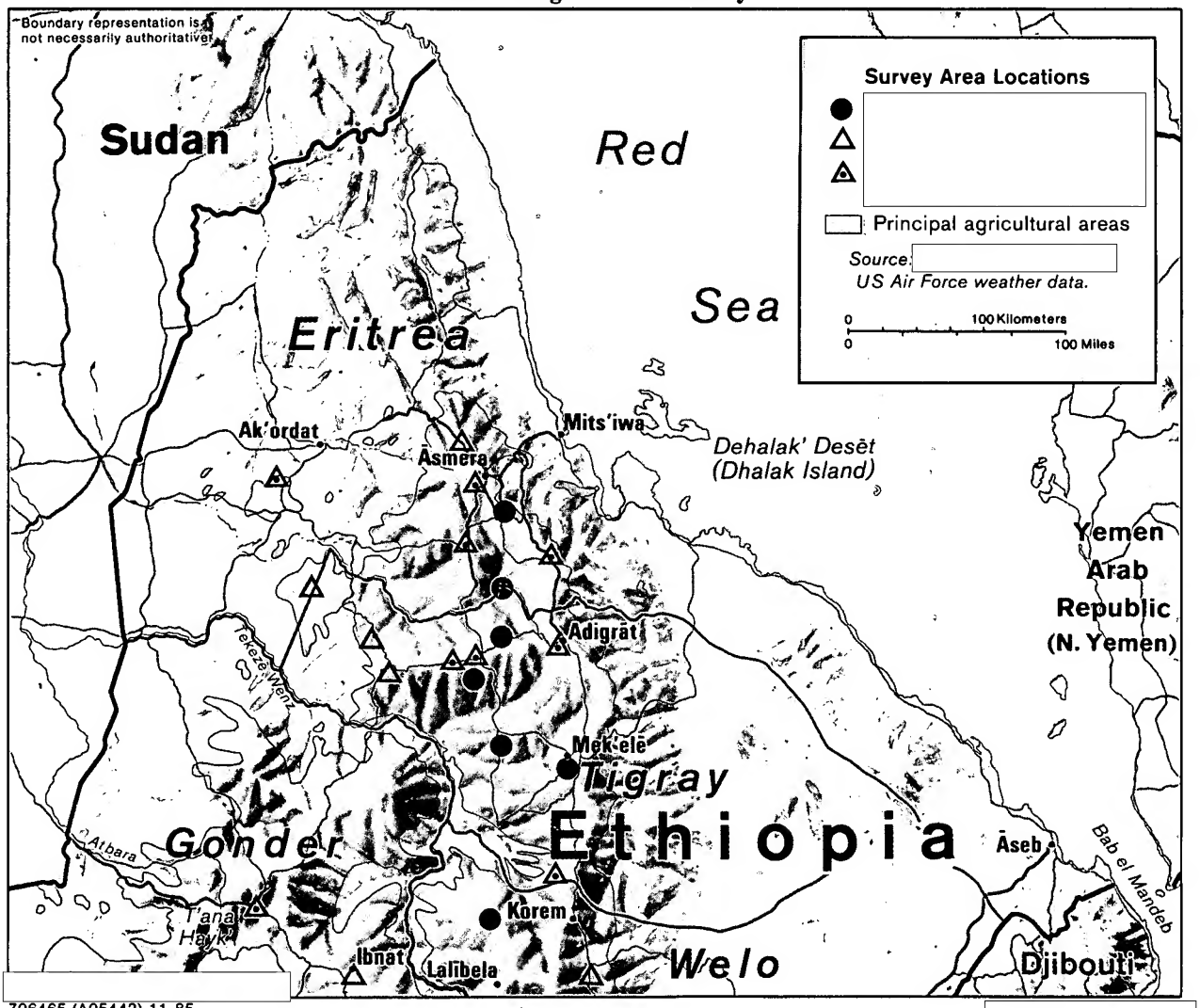
Northern Ethiopia
Survey Area Locations
1984-85 Agricultural Survey



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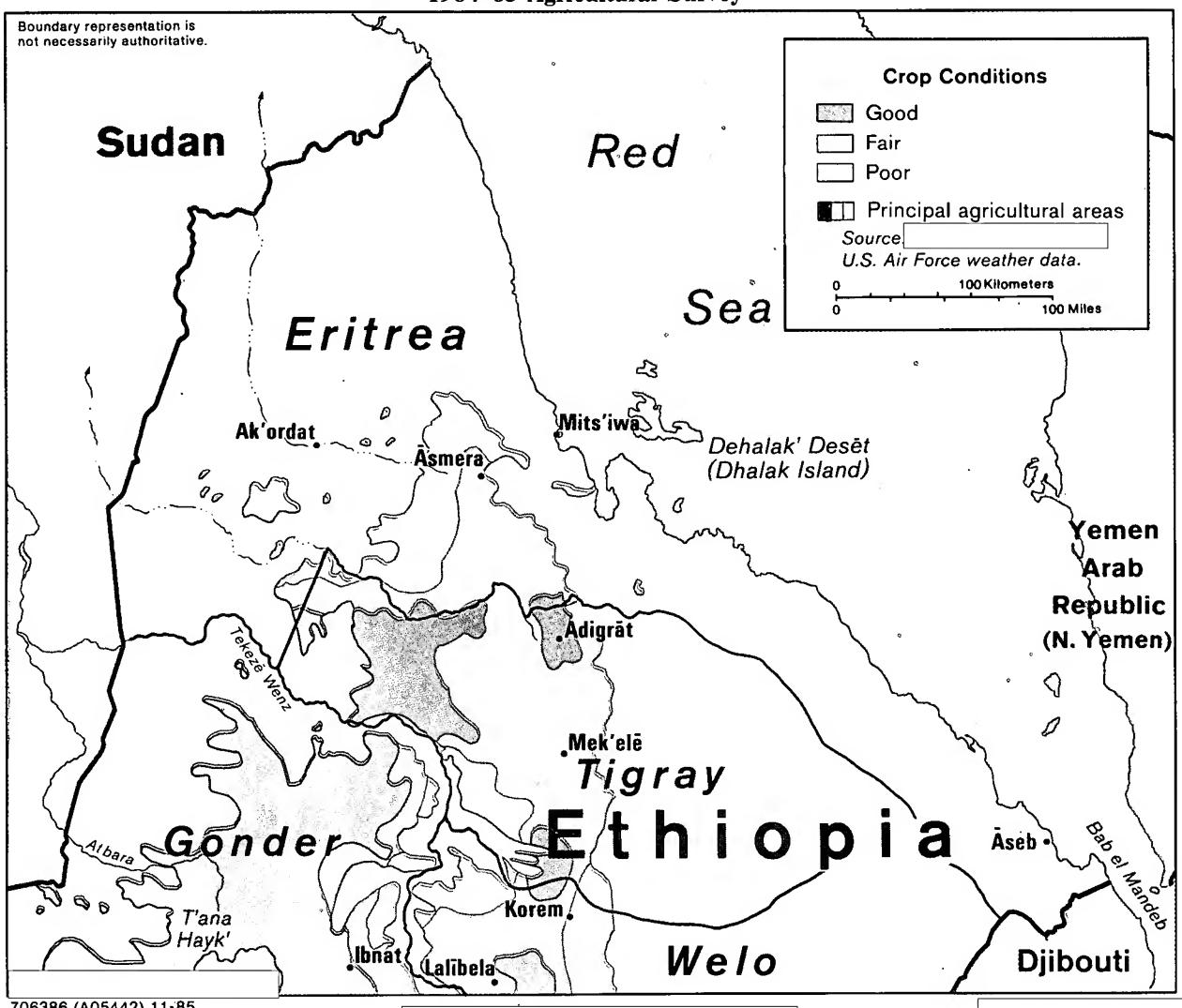
Northern Ethiopia
Crop Conditions 1985
1984-85 Agricultural Survey



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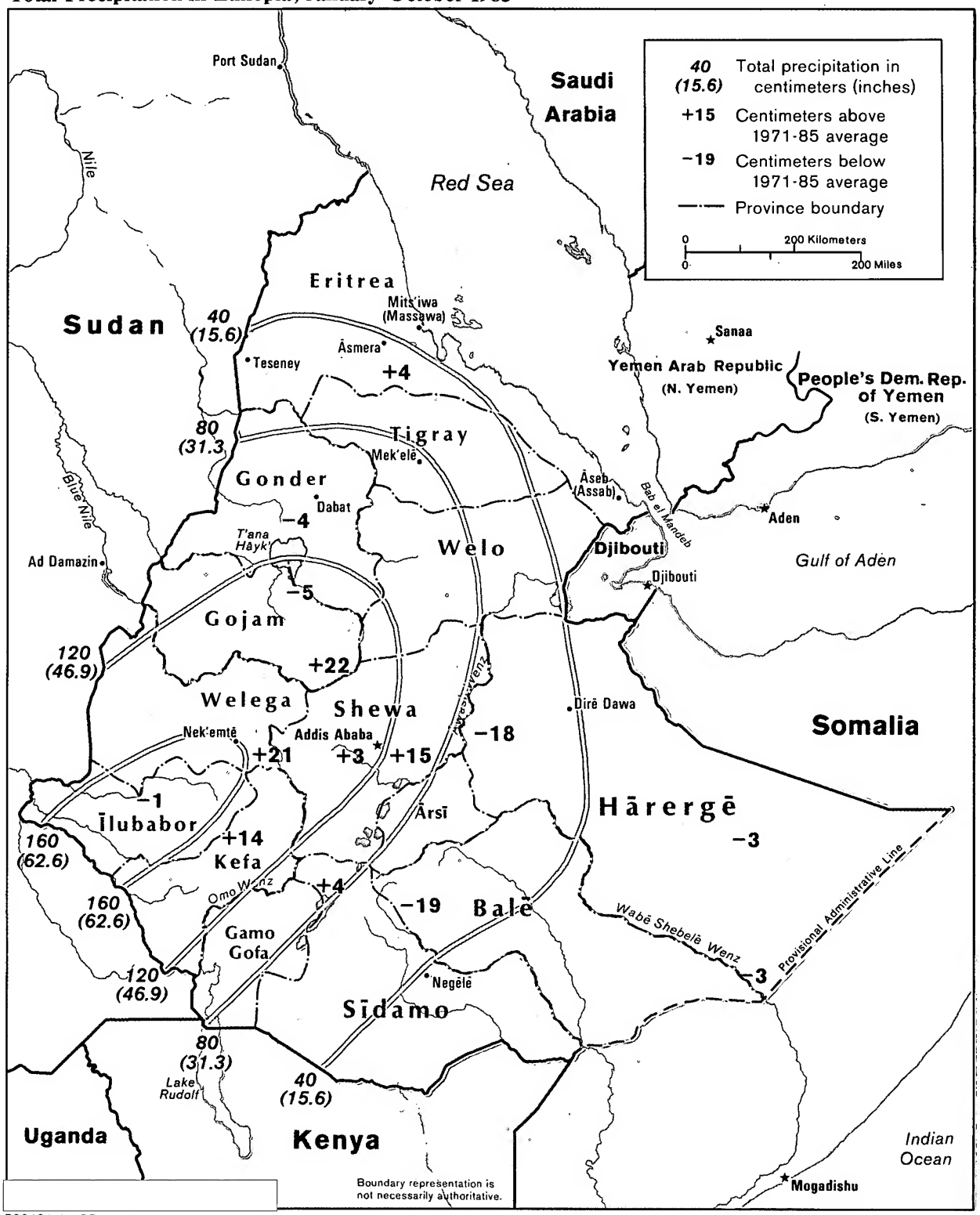
Total Precipitation in Ethiopia, January-October 1985



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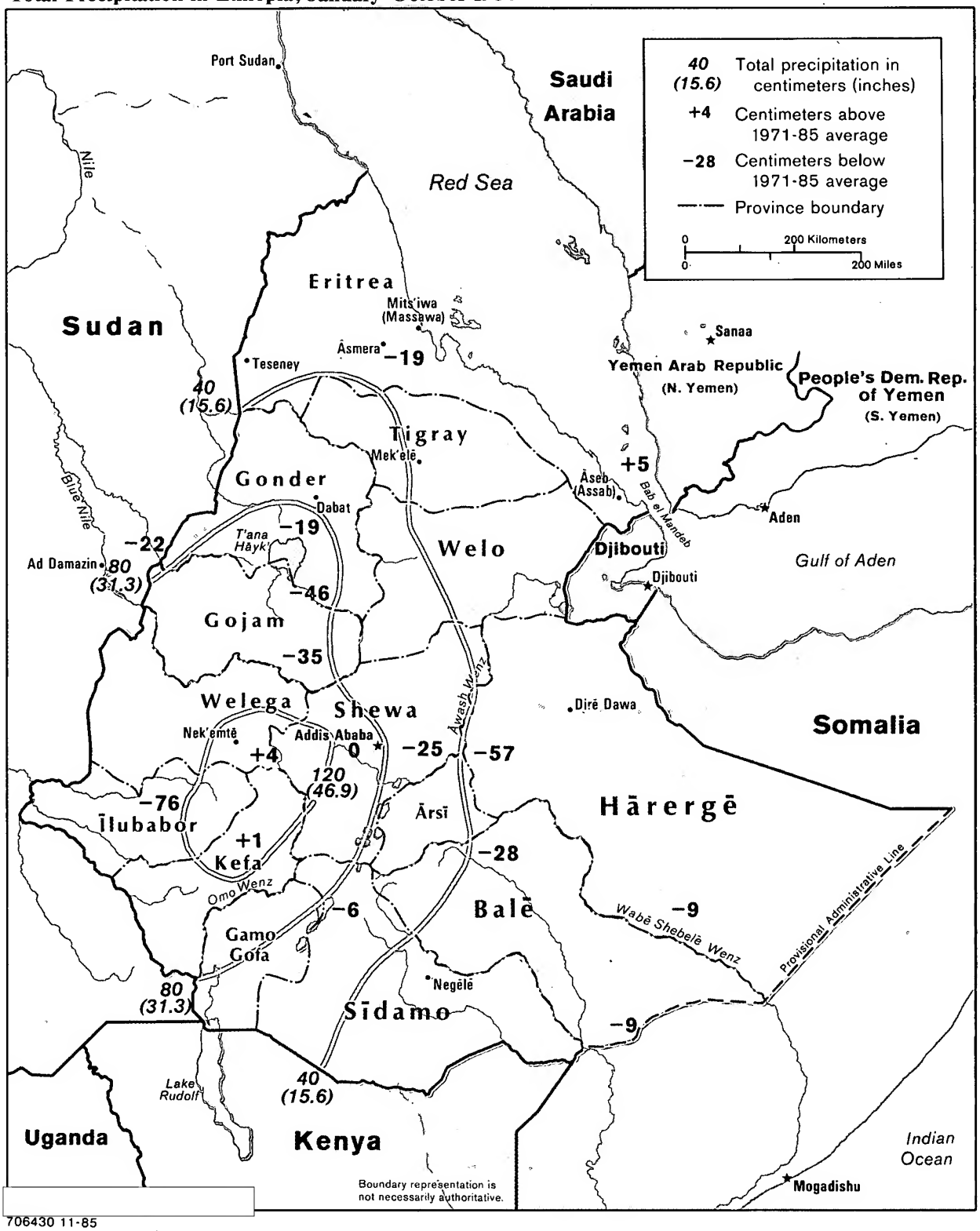
Total Precipitation in Ethiopia, January-October 1984



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